

The need for sustainable production

An agroecological analysis

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Sustainable agriculture

- Agriculture directs resources into target products of nutritional and economic importance.
- There is a growing interest in sustainable patterns of utilisation and production.
- Low input (e.g. integrated) and organic agriculture is a response to these concerns.

Modern agriculture and sustainability

- Much of the modern agriculture has lost the balance needed for long term sustainability (Kimbrell, 2002)
- Agriculture is more than an economic activity designed to produce a crop or to make profit as large as possible
- Today farming is viewed as a much larger system with many interacting parts including:
 - environmental
 - economic,
 - social-cultural components

Modern agriculture and sustainability

- Food production more than kept pace with global population growth.
- On average, food supplies are 24 percent higher per person than in 1961, and real prices are 40 percent lower.
- Agriculture faces an enormous challenge to meet the food needs of an additional 1.7 billion people over the next 20 years.
- Agroecosystems cover about a third of the global land area, but almost three-quarters of the land has poor soil fertility and about half has steep terrain, constraining production.

Modern agriculture and sustainability

- While the global expansion of agricultural area has been modest in recent decades, intensification has been rapid, as irrigated area increased and fallow time decreased to produce more output per hectare.
- About 66 percent of agricultural land has been degraded in the past 50 years by:
 - erosion,
 - salinization,
 - compaction,
 - nutrient depletion,
 - biological degradation,
 - or pollution.
- Over 40 percent of agricultural land has been strongly or very strongly degraded.

Modern agriculture and sustainability

- **Most of industrialised agroecosystems excessively depend on:**
 - fossil fuels,
 - external inputs
- and overuse and degrade:**
 - soil
 - water
 - genetic
 - cultural
- resources**

Goals of the conventional production

- Maximisation of production
- Maximisation of profit

Successes of the conventional production

- Rate of increase in production exceeds the rate of consumption
- Yields have been increased
- Prices for consumers have been declined

due to

- scientific advances
- technological innovations
 - cultivation of improved - selected varieties,
 - use of synthetic fertilisers and pesticides,
 - advances in irrigation technology
- practices
- policies

Practices of conventional production

- **Backbone of conventional production:**
 - intensive tillage
 - monoculture
 - irrigation
 - inorganic fertilisers
 - chemical pest control
- **Each practice depends on others and reinforce using others**
- **Agricultural production is like an industrial process**
 - output is maximised by supplying appropriate inputs
 - efficiency increases by manipulation of genes (high yield varieties)
 - soil is a medium for anchoring crops

Intensive soil cultivation

- Reduction of soil organic matter
- Reduction of soil ability to provide nutrients (soil fertility)
- Degradation of soil structure
- Increased water and air erosion

Monoculture in large areas

- Increases susceptibility to devastating attacks by specific pests
- Requires protection by pesticides

Synthetic fertilisers

- Ignore long term fertility and the processes that maintain it
- Soluble synthetic fertilisers easily leach out of the soil
- Large amounts ends up in streams, lakes and rivers causing eutrophication
- Nutrient leach in groundwater poses health hazard
- Fertiliser cost and availability depends on the petroleum cost and availability

Irrigation

- Groundwater often is pumped faster than it is renewed
- Pumped river water for agriculture competes with water-dependent wildlife and urban areas
- Effects of dams on river ecology
- Increased possibilities of fertiliser leaching
- Increase rate of soil erosion

Chemical control

- Elimination of pest natural predators
- “Pesticide treadmill” (ever increasing use of pesticides)
- Increased resistance of pests
- Increased cost
- Negative effects on environment and human health by entering the food chain

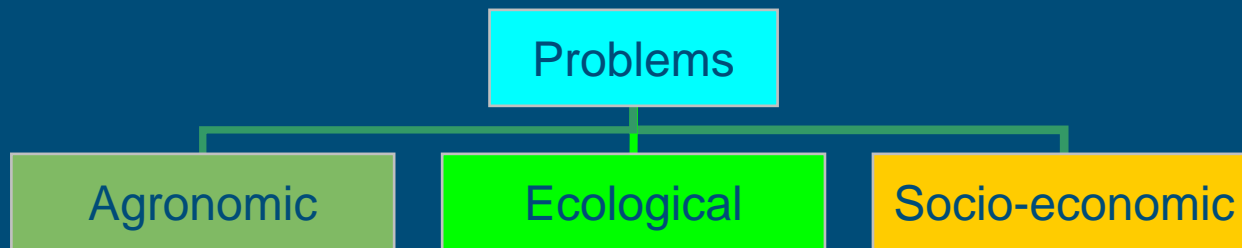
Genetic material manipulation

- Require optimal conditions
- Many have lack of pest resistance

Shortfalls of conventional production

- The improvements undermine the basis of productivity by overdrawn and degraded natural resources:
 - soil
 - water resources
 - natural genetic diversity
- Dependence on non renewable fuel sources
- Production is increasingly out of hands of farmers and farm workers

Problems of conventional production



Agronomic problems of conventional production

- wind and water erosion
- decreasing soil fertility (biological, chemical, physical)
- increasing pressure of pests and pathogens
- increasing resistance of pests
- increasing dependence on pesticides
- imbalances in beneficial fauna
- shortage of water for rainfed agriculture

Ecological problems of conventional production

- depletion of groundwater
- decreased biodiversity
- levelled down landscape
- contamination of air, water and soil with agrochemicals
- environmental pollution with wastes

Socio-economic problems of conventional production

- dependence on price subsidies
 - low added value products
 - decreasing incomes
 - high opportunity cost
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- toxic biocide residues in products
 - health risks for growers and consumers
 - abandoned production in mountainous and less favoured areas

Soil degradation

- **Erosion is the most widespread problem and it is due to:**
 - intensive tillage
 - monoculture
 - irrigation
- **Supply of agricultural soil is finite and natural processes may not renew or restore soil as fast as degraded**

Water waste and overuse

- Water is pumped from underground aquifers faster than it can be recharged
- Half of the irrigation water never is taken by the plants
- Impact on the regional and global hydrological patterns
- Impact due to hydrology and microclimate changes on natural ecosystems and wildlife

Pollution of the environment

■ Agrochemicals:

- kill beneficial organisms and wildlife
- poison farmworkers
- potential health risks to consumers
- negative effects on aquatic ecosystems
- contaminate groundwater and drinking water supplies

External inputs dependence

- Increased inputs = high yields ?
- Dependence on inputs:
 - natural resources of many inputs:
 - non renewable
 - supplies finite
 - farmers, regions, whole countries vulnerable to:
 - price increases
 - supply shortages
 - market fluctuations

Decreased biodiversity

- Crop genetic homogeneity allows standardisation of management practices and mechanisation
- Crops more susceptible to:
 - insect pest and pathogens
 - changes in the environment and climate
- Shrink genetic reservoir for crops